

suggest the use of zeolite ZSM-5 in combination with a USY cracking component. Although the ZSM-5 zeolites are referred to (column 3), the patent itself as examples of known zeolites, the disclosure does not appear to teach the desirability of using these intermediate pore size zeolites in combination with the larger pore materials such as the HY zeolites which are specifically recommended (see column 16, line 41 *et seq.*). Because the claims of the present application, however, would comprehend the use of a single zeolite such as USY with a proportion of the metal sulfur reduction component exchanged onto it, this point need not be taken further.

2.2. The Examiner notes that Beck '702 discloses the general catalytic cracking process but concedes that this reference does not disclose the presence of vanadium in an oxidation state greater than zero, a reduction in the sulfur content or the use of a vanadium containing catalyst. Kugler is cited on the grounds that to assert that it is known in the art that vanadium contaminants in a hydrocarbon feed which remain on a catalyst during regeneration are oxidized, that the oxidized vanadium compounds become mobile and react with the zeolite components of the catalyst, as a result of which the regenerated catalyst in the Kugler process is considered by the Examiner to contain vanadium (Paper No. 23, pages 3 to 4). On this basis, the Examiner has concluded that Kugler discloses "the concept that cracking catalysts operating with vanadium containing feeds contain a vanadium component resulting from contamination during the regeneration process" (Paper No. 23, page 4). In fact, as Kugler makes clear, the actual contamination occurs during the cracking part of the cycle but it is the regeneration process which is responsible for the oxidation of the sorbed vanadium materials. The Examiner continues, stating that "the vanadium component meets applicants' non-lanthanide transitional metal limitation". (The claims now specify that the metal sulfur reduction component is vanadium). On this basis, the Examiner concludes that it would have been obvious to the person of ordinary skill to utilize a vanadium containing catalyst because Kugler teaches that it is known in the art that recycled regenerated catalysts for cracking contain vanadium components. The effect achieved by the catalyst is considered to be an inherent actual result from the use of a catalyst produced by the vanadium containing catalyst in the manner by Beck and Kugler (page 23, page 4).

2.3. Since Kugler deals with the subject of vanadium in cracking catalysts, it bears closer examination. Kugler states the following regarding the described catalytic cracking process:

"This invention relates to a catalyst suitable for use in a fluid catalytic process and a method of using the catalyst on hydrocarbons containing one or more soluble metal poisons (vanadium, nickel, or iron) to convert the hydrocarbons to lower boiling fractions. The catalyst contains one or more particulate, discrete, substantially water-insoluble strontium compounds (in addition to a conventional zeolite and catalyst matrix) which react with and trap the metal poison to preserve the structure of the zeolite and, in addition, lower the coke and hydrogen production". (Column 1, lines 11-22).

2.4. Kugler draws attention to the problem of carrying out catalytic cracking operations with heavier crude which tend to contain substantially more organic metal compounds such as vanadium and nickel porphyrins, pointing out that the metals, specifically nickel and vanadium, are quite harmful to fluidized cracking catalysts, depositing on the cracking catalyst and accumulating with time, to act as poisons with the result that hydrogen and porphyrins are increased and the selectivity for liquid products is decreased. (Column 1, lines 33-48). Kugler subsequently continues with the discussion of the role of vanadium in catalytic cracking process in column 4, lines 4-28 stating that vanadium has been found not only to increase hydrogen and coke yields but also to attack the zeolite itself, as follows:

"The current understanding of metals attack on cracking catalyst indicates that metal porphyrin molecules are deposited on the exterior surface of catalyst particles during cracking. Cracking takes place in the "transfer line" shown in FIG. 1. The porphyrin molecules diffuse poorly and are too large to penetrate the zeolite. Consequently, they probably remain adsorbed onto the first surface of contact. This should produce an eggshell type deposit. After cracking, the product gasoline is steam-stripped from the catalyst and the hydrocarbon residues remaining on the catalyst are burned from the catalyst in the regenerator. Metals present on the catalyst are oxidized in the regenerator.

Although metal porphyrin molecules are probably deposited on the external catalyst surface during cracking, the metallic poisons become mobile at the elevated temperatures present in the regenerator. For instance, vanadium pentoxide melts at 670°C., below most FCCU regenerator temperatures, and therefore may migrate during the catalyst burn. The vanadium may diffuse from its initial exterior position and react with the zeolite or other catalyst components. In a catalyst containing zeolite, clay and binder, the zeolite is usually the most reactive component toward the metal poison."

2.5. Thus, Kugler indicates that oxidation of the vanadium compounds deposited on the cracking catalyst by the cracking reactions result in mobile oxidized vanadium compounds which permeate the catalyst particles to act as a metal poison on the zeolite component of

the catalyst. The actual manner in which the poison operates is not disclosed by Kugler but reference to earlier Beck patent, U.S. 4,432,890, is indicative of what the skilled person in the art would have known at the time of Kugler publication and therefore read into Kugler's disclosure. Beck '890 states the following (column 7, lines 18-28).

"At the elevated temperatures encountered in the regeneration zone, the vanadium deposited on the catalyst in the riser is converted to vanadium oxides, in particular, vanadium pentoxide. The melting point of vanadium pentoxide is much lower than the temperatures encountered in the regeneration zone. Thus, it can become a mobile liquid and flow across the catalyst surface, causing pore plugging, particle coalescence, and more importantly, entering the pores of the zeolite, *where it catalyzes irreversible crystalline collapse of zeolite to form an amorphous material.*"

2.6. The disclosure in Beck '890 cited above is consistent with the disclosure in Kugler but takes it further in stating the exact role of the vanadium poison. Kugler states the liquefied vanadium compounds become a mobile liquid and flow across the catalyst surface, causing pore plugging, particle coalescence and, more importantly, entering the pores of the zeolite, where it catalyzes "*irreversible crystalline collapse of zeolite to form an amorphous material*". Thus, the vanadium sorbed on the cracking catalyst during the cracking portion of the cycle becomes transformed to a higher oxidation state in the regenerator where it causes the collapse of the zeolite to form an amorphous material, which by definition, *is no longer a zeolite* (crystalline material) which would be effective to continue cracking activity. Thus, the vanadium poisoned zeolite containing catalysts cannot be concluded as containing a zeolite oxidation state greater than zero within the internal pore structure of the zeolite since the vanadium has caused the collapse of the pore structure of the zeolite so that the zeolite no longer exists when the vanadium has poisoned it. Also, since the vanadium compounds have caused the collapse of the zeolite pore structure, it can scarcely be held that the vanadium is within the pore structure of any material, crystalline or amorphous. In fact, the location and form of the vanadium compounds are quite ambiguous.

2.7. Thus, notwithstanding the Examiner's assertion, it is clear as a factual matter that the presence of vanadium in the feeds to the catalytic cracking process does *not* disclose a catalyst falling within the terms of applicants' present claims which call for the zeolite structure to be present so as to retain the vanadium incorporated during the manufacturing

process within the characteristic pore structure. The rejection based on Beck '702 and Kugler is therefore factually unsupportable. The references when read in the light of the understanding of the skilled person at the relevant time would not convey the appropriately skilled person, the desirability - in fact, the possibility - of utilizing a catalyst in the catalytic cracking process which contained vanadium within the pore structure of the zeolite in an oxidation state greater than zero.

2.8. It is apparent from this discussion that vanadium functions rather differently when incorporated into the zeolite cracking catalyst during the manufacturing process as distinct from being incorporated as a poisoning contaminant during the cracking process itself. It is pointed out that the present claims are effectively limited to the use of catalysts in which the vanadium is incorporated during the cracking process by reference to the fact that the vanadium is present within the interior pore structure of the zeolite which, as noted above, is a characteristic which is not secured by the use of a cracking catalyst which does not contain intentionally incorporated vanadium in the manner claimed in the present claims.

2.9. This distinction is emphasized by the addition of claims 32 to 37 which point out that the vanadium is incorporated during the manufacturing process prior to introduction of catalysts into the FCC unit. In view of the deleterious effects of vanadium, it is submitted that the person of ordinary skill in the art would not have sought to incorporate this metal into cracking catalysts, under the apprehension that the vanadium, when present in the catalyst itself, could lead to deleterious results referred to by Beck and Wormsbecher and others. For these reasons, the rejection based on the Beck and Kugler references is considered to be unwarranted by the facts.

3.1. Claim 9 has been rejected as unpatentable under 35 USC 103(a) in view of the Beck, Kugler and Cooper (U.S. 5,601,798) references. Beck and Kugler are applied in the manner discussed above and Cooper is relied upon to show that zeolite USY, as referred to in claim 9, typically has a unit cell size from 2.45nm to 2.46nm and a silica-alumina ratio ranging from 5 to 12. The Examiner's point is that it would have obvious to one of ordinary skill in the art to utilize the unit cell size and silica-alumina ratio disclosed by Cooper for the USY catalyst referred to in Beck '890.

3.2. To expedite consideration of the real issues in this application - which is the use of the intentionally added vanadium to the cracking catalyst - Applicant will not dispute the applicability of Cooper to the recited UCS of zeolite USY but will contest the rejection itself, submitting that it is considered to be unjustified by the facts. The Kugler and Beck references do not disclose the possibility or desirability of using intentionally added vanadium in an oxidation state greater than zero within the interior pore structure of the zeolite in a cracking catalyst for sulfur containing feeds.

4. Claims 11, 12, 14 and 16 to 19 which define the cracking process itself are rejected in view of Beck '702 and Kugler with additional reference to Occelli (U.S. 4,615,996) which is cited for the general teaching that it is conventional in the art to use fluid catalytic cracking catalyst with particle sizes of less than 75 microns. Applicants concede the fact that FCC catalysts typically have particle sizes less than 75 microns but contest the correctness of this rejection since Kugler and Beck do not suggest the desirability of the cracking catalyst containing vanadium in the form set out in the present claims, for the reasons set out above.

5. Claim 15 is rejected over the combined teachings of Beck '702, Kugler, Ocelli and further in view of Cooper probably for the reasons advanced in the earlier rejections, although unstated. Applicant rejects the Examiner's reasoning for the grounds set out above with respect to Beck and Kugler and considers that this rejection is unjustified by the facts.

6.1. The rejection based on Balko (U.S. 5,965,474) in view of Schorfheide (U.S. 4,690,806) and Kugler is explained in the Examiner's argument on pages 7 and 8 of Paper No. 23.

6.2. The Examiner points out that Balko discloses a catalytic cracking process using a catalyst containing a zeolite such as USY, an intermediate pore size zeolite such as ZSM-5 and a very large pore component which may be one of the materials known as an ultra large pore crystalline material, preferably M41S, as described in the patent. The Examiner notes that Balko does not state anything about the presence of sulfur in the feed in the form of organosulfur compounds and sulfur reduction of the feed (note that sulfur reduction of the *feed* should be clarified as to whether this results in a reduction of the sulfur compounds in the liquid products or in the emissions from the regenerator of sulfur oxides). The Examiner

states that Balko discloses a cracking process involving the use of catalysts with components corresponding to those claimed by Applicant (Paper No. 23, page 7) but somewhat contradictorily also states that Balko does not disclose a vanadium catalyst component (also page 7). It is undisputed that Balko does not disclose a sulfur containing feed, as the Examiner correctly notes. The deficiency in the Balko reference with respect to the sulfur component of cracking feed is, by the Examiner's assertion, remedied by reference to Schorfheide which undoubtedly refers to the presence of sulfur in cracking feeds. In any event, since cracking feeds such as gas oils conventionally contain significant quantities of sulfur, Applicant will not dispute this as a characterization of high boiling gas oil type feeds.

6.3. Balko does refer to the presence of vanadium in cracking feeds as a problem and includes the ultra large size pore size materials such as M41S as a material which provides better support for metals passivating compounds than the amorphous catalyst matrix materials which were used previously (column 2, lines 63-67). The metal passivators used in the past, as referred to be Balko, include materials such as lanthanum, oxide or other rare earth oxides as disclosed in U.S. 4,921,824 (see Balko, column 2, lines 38-42). Alkaline or rare earth compounds as disclosed in U.S. 5,258,114 (Balko, column 2, lines 33-37). It is undisputed that the Balko cracking catalyst is described to contain a zeolite component but it would not be a catalyst "corresponding to those claimed by Applicants", as the Examiner states. The metal passivators supported in the ultra large pore size component of the Balko catalysts would passivate the vanadium and preclude its access to the zeolite component of the catalyst so that the vanadium would not enter the pore structure of the zeolite. This, of course, assumes the success of the vanadium passivator. If, however, the passivator were not completely successful in trapping the vanadium from the feed, the zeolite would be destroyed as noted with respect to the Kugler disclosure so that the vanadium would not be present in the form claimed by Applicant (see Section 2.6 above).

6.4. The Examiner continues by citing Kugler for the proposition that it is conventional to oxidatively regenerate FCC catalyst (Paper No. 23, page 8). Applicant does not dispute the utter conventionality of oxidatively regenerating FCC catalysts during the FCC cycle. Kugler is relied upon (page 8) in a statement that since this reference discloses that regenerated cracking catalysts contain vanadium components (derived from vanadium containing feeds) it would have been obvious to utilize a vanadium containing catalyst. But

this argument ignores the condition in which the vanadium is present in Applicant's catalysts in comparison to Kugler's. As pointed out above, Kugler does *not* disclose the possibility or desirability of using a cracking catalyst with a zeolite containing vanadium in an oxidation stage greater than zero within the interior pore structure of the zeolite. For this reason, the rejection based on Balko, Kugler and Schorfheide is unwarranted and should be withdrawn.

7. The final prior art rejection is based on the Balko, Schorfheide, Kugler and Cooper references, being applied to claims 9 and 15. Cooper is applied as in the previous rejection of claims 9 and 15 with respect to the UCS of zeolite USY. As noted above, applicant does not contest the characterization of the UCS of zeolite USY. For this reason the reference essentially adds nothing to whatever is described or suggested in the Balko, Schorfheide and Kugler references discussed in the previous section. For the reasons set out in Section 2 above, Applicant submits that rejection is untenable and should be withdrawn.

8. Claims 1, 2, 4, 5 and 10 to 14 have been provisionally rejected patentable over claims 1 to 3, 8 to 10 and 12 of copending application no. 09/221,539 (Mobil Case No. 10101) in view of Beck '702. This rejection is unjustified because even if Beck '702 teaches that rare earth components are known promoters in catalytic cracking processes (column 10, lines 52 to 55), there is no suggestion in Beck that it would be desirable to use these cerium and lanthanum oxide compounds in combination with a vanadium sulfur reduction component. The same consideration holds true with respect to the double patenting rejection based on copending application no. 09/221,540 (Mobil Case No. 10102) for the same reasons.

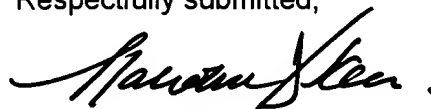
9. The Guthrie reference cited without being applied is stated to show that metal contaminants such as vanadium are known to block the internal channels of the zeolites in cracking catalysts, the Examiner referring to the disclosure in Guthrie at column 5, lines 37-44. The passage refers to blockage of internal channels as a result of coke formation and contamination by metals poisoning which may take place from the presence of vanadium, as taught in column 1 of Guthrie. This suggestion is consistent with the disclosure in Beck that the presence of vanadium in its oxidized state will result in collapse of the zeolite pore structure, a phenomenon which would clearly result in pore blockage in the catalyst. This reference, however, is not considered any more relevant than Kugler since it deals only with the poisoning of zeolite containing cracking catalysts by vanadium taken up from the feed,

rather than as an intentionally added component of the cracking catalyst prior to introduction to the cracking process.

10. The disclosure of Beck '890 has been discussed previously, especially in its application to the condition in which vanadium is present in known types of cracking catalysts used with conventional vanadium and sulfur containing cracking feeds.

11. In view of the remarks set out above, reconsideration and withdrawal of the rejections are requested.

Respectfully submitted,



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